

TITLE OF THE INVENTION

MASK TRADING SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is based upon and claims the  
benefit of priority from the prior Japanese Patent  
Application No. 2001-087470, March 26, 2001, the  
entire contents of which are incorporated herein by  
reference.

BACKGROUND OF THE INVENTION

10 1. Field of the Invention

The present invention relates to a mask trading  
system and method for trading through a network a photo  
mask used for manufacturing semiconductor devices.

2. Description of the Related Art

15 In general, trading of a photo mask used for  
manufacturing semiconductor devices proceeds basically  
as follows: First, a mask buyer gives a written order  
to a mask manufacturer. The written order contains  
various information, such as design specifications,  
20 quantity, desired delivery date, and examination  
specifications of the mask. The mask manufacturer  
manufactures the ordered mask in a factory in  
accordance with the written order. Then, the mask  
manufacturer examines the manufactured mask product.  
25 If the examination data of the product does not conform  
to the specifications in the written order, the mask  
manufacturer re-manufactures the mask. In such

a manner, the mask manufacturer repeats the manufacture and examination of the mask until a manufactured mask product conforms to the specifications in the written order. Then, the final mask product is delivered to the buyer.

#### BRIEF SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a system for trading a photo mask used for manufacturing semiconductor devices, comprising:

a purchase mediating section configured to exchange information with a mask buyer through a network;

a factory mediating section configured to exchange information with a mask factory;

a manufacture order storing section configured to store a mask manufacture order, which is inputted through the purchase mediating section, and includes at least one of design specifications, a quantity, a desired delivery date, and examination specifications of a mask;

a line information storing section configured to store line information, which is inputted through the factory mediating section, and includes a processing ability state of a manufacturing line in the mask factory;

a price information storing section configured to

store price information, which includes relationships between contents of mask manufacture orders and mask trading prices;

5 a calculating section configured to calculate an estimated price and an estimated delivery date of a mask product with reference to the price information and the line information, in response to the mask manufacture order;

10 a progress selecting section configured to transmit the estimated price and the estimated delivery date to the mask buyer through the purchase mediating section, and allow the mask buyer to select whether to proceed with manufacture of the mask or not; and

15 a manufacture instructing section configured to transmit the mask manufacture order to the mask factory through the factory mediating section, when proceeding with manufacture of the mask is selected.

20 According to a second aspect of the present invention, there is provided a mask trading method of trading a photo mask used for manufacturing semiconductor devices, using a system including a purchase mediating section configured to exchange information with a mask buyer through a network, and a factory mediating section configured to exchange  
25 information with a mask factory, the method comprising:

storing a mask manufacture order, which is inputted through the purchase mediating section, and

includes at least one of design specifications,  
a quantity, a desired delivery date, and examination  
specifications of a mask;

5 storing line information, which is inputted  
through the factory mediating section, and includes  
a processing ability state of a manufacturing line in  
the mask factory;

10 storing price information, which includes  
relationships between contents of mask manufacture  
orders and mask trading prices;

calculating an estimated price and an estimated  
delivery date of a mask product with reference to the  
price information and the line information, in response  
to the mask manufacture order;

15 transmitting the estimated price and the estimated  
delivery date to the mask buyer through the purchase  
mediating section, and allowing the mask buyer to  
select whether to proceed with manufacture of the mask  
or not; and

20 transmitting the mask manufacture order to the  
mask factory through the factory mediating section,  
when proceeding with manufacture of the mask is  
selected.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

25 FIG. 1 is a block diagram showing the relationship  
within a system for trading a photo mask used for  
manufacturing semiconductor devices, terminal units on

a mask buyer side, and a mask factory, according to an embodiment of the present invention;

5 FIG. 2 is a flowchart showing a business flow of a mask trading method performed by the system shown in FIG. 1;

FIG. 3 is a flowchart showing a system flow of the mask trading method performed by the system shown in FIG. 1;

10 FIG. 4 is a view showing a screen picture displayed for a mask buyer to input a mask manufacture order;

FIG. 5 is a view showing a screen picture displayed for a mask buyer to select whether to proceed with manufacture of the mask or not;

15 FIG. 6 is a view showing a screen picture displayed for the mask buyer, when examination results on a mask product conform to examination specifications set out in the mask manufacture order;

20 FIG. 7 is a view showing a screen picture displayed for the mask buyer, when examination results on a mask product do not conform to examination specifications set out in the mask manufacture order; and

25 FIG. 8 is a view showing another screen picture displayed for the mask buyer, when examination results on a mask product do not conform to examination specifications set out in the mask manufacture order.

# DETAILED DESCRIPTION OF THE INVENTION

In the process of developing the present invention, the present inventors studied the conventional mask trading method described above. As a result, the present inventors have obtained the following findings.

Under the current state of affairs, a mask product is judged as to whether it is good or not, on the basis only of the dimensions and number of defects formed in the mask product. Accordingly, as the present inventors have found, some mask products acceptable in practice may be judged to be inferior goods in the following two cases. Namely, one of them is a case where defects in a mask product are not transferred onto a semiconductor wafer in a semiconductor manufacturing process. The other is a case where defects in a mask product are transferred onto a semiconductor wafer in a semiconductor manufacturing process, but cause no problems in the performance of a semiconductor device.

In general, several tens of defects are detected on one mask product in examination performed after it is manufactured in a mask factory. As a mask pattern is downsized, the defect specifications become stricter and the yields of mask products become lower. As a result, a sequence of mask manufacture, mask examination, and mask re-manufacture is sometimes

repeated within a mask manufacturer side. It follows that, a mask buyer cannot know when the buyer receive the ordered mask, while a mask manufacturer produces a lot of inferior goods, thereby falling into a busy state without profit.

In addition, after the buyer places an order, information regarding an estimated price and an estimated delivery date is sometimes long in coming from a mask manufacturer. This not only wastes time, but also makes it more difficult for the buyer to choose the most suitable mask manufacturer.

Accordingly, it is preferable to better the communication between a mask buyer and a mask factory, so as to shorten the period from a mask order to a mask product delivery. It is also preferable to better the communication between a mask buyer and a mask factory, so as to prevent such wastage in which mask products having non-serious defects are scraped.

Embodiments of the present invention achieved on the basis of the findings given above will now be described with reference to the accompanying drawings. In the following description, the constituent elements having substantially the same function and arrangement are denoted by the same reference numerals, and a repetitive description will be made only when necessary.

FIG. 1 is a block diagram showing the relationship

within a system for trading a photo mask used for manufacturing semiconductor devices, terminal units on a mask buyer side, and a mask factory, according to an embodiment of the present invention.

5           In this embodiment, a host apparatus (imaginary factory) 20 of the mask trading system is disposed at site accessible by a user's terminal unit 14, such as a personal computer, through a network 12, particularly through the transmission lines of the Internet (public  
10 communication network). Accordingly, the host apparatus 20, i.e., a host computer (including a web server, application server, and database server), has a purchase agent (purchase mediating section) 22, which is connected to the network 12 and used as a window to  
15 exchange information with a mask buyer. The host apparatus 20 also has a factory agent (factory mediating section) 24, which is connected to an exclusive line 62 to the mask factory 60 and used as a window to exchange information with the mask  
20 factory 60. Reference symbols 16 and 18 in FIG. 1 denote modems and a connection server, respectively.

          The host apparatus 20 is provided with a database 40, in which a manufacture order file 42, a line information file 44, a price information file 46,  
25 an examination data file 48, and so forth are formed. The manufacture order file 42 is used to store a mask manufacture order, which includes the design



specifications, quantity, desired delivery date,  
examination specifications, and so forth of an ordered  
mask, and is inputted through the purchase agent 22.  
Where product names or product numbers of masks are set  
5 in advance between a mask buyer and the mask factory  
60, the product names or product numbers of masks  
can be used as information representing mask  
specifications. The line information file 44 is used  
to store line information, which includes the state of  
10 the processing abilities of manufacturing lines in the  
mask factory 60, and is inputted through the factory  
agent 24, as required. The price information file 46  
is used to store price information, which includes the  
relationships between the contents of mask manufacture  
15 orders and mask trading prices.

The examination data file 48 is used to store the  
examination data of a mask product manufactured in the  
mask factory 60, which is inputted through the factory  
agent 24. The examination data includes the coordinate  
20 positions and dimensions of defects generated in the  
mask product, and, if necessary, further includes the  
number of defects and image data thereof. Furthermore,  
the examination data may include an optical simulation  
image to be formed when the mask product is used for  
25 a wafer. The contents of the examination data can be  
suitably changed, depending on, e.g., examination  
specifications set out in a mask manufacture order

inputted by a mask buyer.

In order to perform a first stage mediation between a mask buyer and the mask factory 60, utilizing the above-described information stored in the database 40, the host apparatus 20 has a calculating section 26, a progress selecting section 28, a manufacture instructing section 32, and so forth. The calculating section 26 calculates an estimated price and an estimated delivery date of a mask product with reference to the price information and the line information described above, in response to a mask manufacture order inputted through the purchase agent 22. The progress selecting section 28 transmits the estimated price and the estimated delivery date to the mask buyer through the purchase agent 22, and allows the buyer to select whether to proceed with manufacture of the mask or not. The manufacture instructing section 32 transmits the mask manufacture order to the mask factory 60 through the factory agent 24, when proceeding with manufacture of the mask is selected.

Furthermore, in order to perform a second stage mediation between the mask buyer and the mask factory 60, utilizing the above-described information stored in the database 40, the host apparatus 20 has an examination data transmitting section 34, a purchase selecting section 29, a re-manufacture selecting

section 31, a re-manufacture instructing section 33,  
and so forth. The examination data transmitting  
section 34 transmits examination data to the mask buyer  
through the purchase agent 22. The purchase selecting  
5 section 29 allows the mask buyer through the purchase  
agent 22 to select, on the basis of the examination  
data, whether to buy the mask product or not. The  
purchase selecting section 29 also has a portion 30,  
which allows the mask buyer through the purchase  
10 agent 22 to input a desired purchase price of the  
mask product on the basis of the examination data.  
This portion 30 is effective, for example, where  
the mask product has defects but is acceptable.  
The re-manufacture selecting section 31 allows the mask  
15 buyer through the purchase agent 22 to select, on  
the basis of the examination data, whether to  
re-manufacture the mask or not. The re-manufacture  
instructing section 33 instructs re-manufacture of  
the mask to the mask factory 60 through the factory  
20 agent 24, when re-manufacture of the mask is selected.

In the mask factory 60, the mask manufacturing  
lines are administered by a manufacturing line  
administering section 64 formed of, e.g., a computer.  
The mask factory 60 is connected to the host apparatus  
25 20 of the mask trading system only by a data  
administering section 66 formed of, e.g., a computer.  
The manufacturing line administering section 64 and

the data administering section 66 are connected to  
a common factory database 68. The factory database 68  
is used to store information transferred to and from  
the host apparatus 20 of the mask trading system, i.e.,  
5 a mask manufacture order from a mask buyer, line  
information of the manufacturing lines, examination  
data of a mask product, and so forth.

The progress state of a mask being manufactured  
in accordance with a mask manufacture order may be  
10 inputted into the factory database 68 from the  
manufacturing line administering section 64, as  
required. In this case, the database 40 of the host  
apparatus 20 of the mask trading system may be provided  
with a corresponding file, so that the progress  
15 state of the mask being manufactured is transmitted  
from the data administering section 66 of the mask  
factory 60, and is stored in the database 40 of the  
host apparatus 20. With this arrangement, the mask  
buyer can be informed of the progress state of the mask  
20 being manufactured through the purchase agent 22, if  
necessary.

FIGS. 2 and 3 are flowcharts showing a business  
flow and a system flow, respectively, of a mask trading  
method performed by the system shown in FIG. 1.  
25 An explanation will be given of a mask trading method  
with reference to FIGS. 2 and 3.

First, a mask buyer connects a user terminal

unit 14 to the host apparatus 20 of the mask trading system through the network 12 (steps G1 to G4: step S1). In the flowchart shown in FIG. 2, the connection server 18 is shown to require an ID and a password, when a user terminal unit 14 is connected to the host apparatus 20. In this case, only users with a specific contract are allowed to access the host apparatus 20.

After the user terminal unit 14 is connected to the host apparatus 20, the mask buyer inputs a mask manufacture order including the design specifications, quantity, desired delivery date, examination specifications, and so forth of the ordered mask, through the purchase agent 22 (step G5: step S2). The host apparatus 20 stores the inputted mask manufacture order in the manufacture order file 42 of the database 40. FIG. 4 is a view showing a screen picture displayed for a mask buyer to input a mask manufacture order. In FIG. 4, "Product Name" can be used where product names or product numbers of masks are set in advance between the mask buyer and the mask factory 60. In other words, a product name or product number of a mask is used as information representing specifications of the mask, as the case may be.

On the other hand, line information including the state of the processing abilities of the manufacturing

lines is inputted from the mask factory 60 through  
the factory agent 24, as required (step S3),  
and is stored in the line information file 44 of  
the database 40. At this time, price information  
5 including the relationships between the contents of  
mask manufacture orders and mask trading prices has  
already been stored in the price information file 46 of  
the database 40.

The line information stored in the line  
10 information file 44 may be renewed, for example, every  
time a mask manufacture order is inputted. More  
specifically, in this case, when a mask manufacture  
order is inputted through the purchase agent 22, the  
host apparatus 20 inquires of the mask factory 60  
15 the latest line information on the mask manufacturing  
lines. In response to this inquiry, the latest line  
information is inputted from the mask factory 60 to the  
factory agent 24. The host apparatus 20 renews the  
line information in the line information file 44 with  
20 the latest line information.

Back to FIG. 3, when the mask manufacture order is  
inputted, the host apparatus 20 decides whether the  
ordered mask can be manufactured or not (step S4).  
Where the mask cannot be manufactured ("No" in  
25 step S4), the mask buyer is informed of this fact, and  
the trading does not come into effect (step S5).  
Alternatively, where the mask cannot be manufactured

("No" in step S4), the mask buyer is informed of this fact, and may be allowed to change the content of the mask manufacture order (step S6).

Where the mask can be manufactured, the  
5 calculating section 26 calculates an estimated price  
and an estimated delivery date of a mask product, with  
reference to the price information and the line  
information (step G6: step S7). The progress selecting  
section 28 transmits the calculated estimated price and  
10 estimated delivery date to the mask buyer through the  
purchase agent 22 (step S8), and allows the buyer to  
select whether to proceed with manufacture of the mask  
or not (step S9).

FIG. 5 is a view showing a screen picture  
15 displayed for a mask buyer to select whether to proceed  
with manufacture of the mask or not. When the mask  
buyer selects not to proceed with the manufacture  
("No" in step S9), the trading does not come into  
effect (step S10). On the other hand, when the mask  
20 buyer selects to proceed with the manufacture ("Yes" in  
step S9), the manufacture instructing section 32  
transmits the mask manufacture order to the data  
administering section 66 of the mask factory 60 through  
the factory agent 24 (step G7: step S11).

25 Upon receiving the mask manufacture order,  
the data administering section 66 provides the  
manufacturing line administering section 64 with

a manufacture instruction (step S12). On the basis of this, the manufacturing line administering section 64 conducts manufacture of a mask product in the manufacturing lines (step G8: step S13). After the mask product is completed, an examination of the product is performed in the mask factory 60 to form examination data (step G9: step S14). The examination data includes the coordinate positions and dimensions of defects generated in the mask product, and, if necessary, further includes the number of defects and image data thereof. Furthermore, the examination data may include an optical simulation image to be formed when the mask product is used for a wafer.

The data administering section 66 of the mask factory 60 inputs the examination data to the host apparatus 20 through the factory agent 24, while clarifying the relationship of the examination data relative to the corresponding mask manufacture order. The host apparatus 20 stores the inputted examination data in the examination data file 48 of the database 40, and causes the examination data transmitting section 34 to transmit the examination data to the mask buyer through the purchase agent 22 (step G10: step S15). With reference to the examination data, the mask buyer selects whether to buy the mask product or not, and/or whether to re-manufacture the mask or not, through the purchase selecting section 29 and



the re-manufacture selecting section 31 of the host apparatus 20 (step G11: step S16).

FIG. 6 is a view showing a screen picture displayed for the mask buyer, when the examination results on the mask product conform to the examination specifications set out in the mask manufacture order. In the normal situation, the mask buyer selects the "OK" button ("Yes" in step S16). The host apparatus 20 considers this as a mask purchase request, and transmits it to the mask factory 60 (step G12: step S17). Thereafter, the mask product is wrapped and delivered from the mask factory 60 (step G13: step S18), and then is received by the mask buyer (step G14: step S19), who sequentially pays for the mask. When the mask buyer does not select the "OK" button in the screen picture shown in FIG. 6, it is necessary to take exceptional procedures, and thus their explanation will be omitted.

FIG. 7 is a view showing a screen picture displayed for the mask buyer, when the examination results on the mask product do not conform to the examination specifications set out in the mask manufacture order. As described above, even if the mask product does not conform to the examination specifications, there is a case where defects in the mask product are not transferred onto a semiconductor wafer in a semiconductor manufacturing process, or

a case where defects in the mask product are transferred onto a semiconductor wafer in a semiconductor manufacturing process, but cause no problems in the performance of a semiconductor device.

5 Accordingly, even where the mask product does not conform to the examination specifications, it is preferable to give the mask buyer a chance to analyze the examination data. If the defects are in a permissible range, the mask product may be purchased,  
10 thereby preventing a waste of mask products.

For this reason, the screen picture shown in FIG. 7 displays, along with the examination data, three selection buttons of "Purchase", "Purchase + Re-manufacture", and "Re-manufacture", and a column into  
15 which a desired purchase price (a discounted price) of the mask product having defects is inputted. When the mask buyer selects the "Purchase" button without inputting any desired purchase price ("Yes" in step S16), the host apparatus 20 receives this as  
20 a mask purchase request, and transmits it to the mask factory 60 (step G12: step S17). When the mask buyer selects the "Purchase" button while inputting a desired purchase price, the host apparatus 20 receives this as a mask purchase request after due consideration by  
25 a suitable assessing section, and transmits it to the mask factory 60 (step G12: step S17). In these cases, thereafter, the mask product is wrapped and delivered

from the mask factory 60 (step G13: step S18), and then is received by the mask buyer (step G14: step S19), who sequentially pays for the mask.

5 In the screen picture shown in FIG. 7, when the mask buyer selects the "Re-manufacture" button ("No" in step S16), the host apparatus 20 receives this as a mask re-manufacture order. In this case, the re-manufacture instructing section 33 transmits the mask re-manufacture order to the data administering section 66 of the mask factory 60 through the factory agent 24 (step G15: step S20). Upon receiving the mask manufacture order, the data administering section 66 provides the manufacturing line administering section 64 with a re-manufacture instruction (step G16: 10 step S21). On the basis of this, the manufacturing line administering section 64 conducts re-manufacture of a mask product in the manufacturing lines (step G8: step S13). Then, the steps from the examination step (step G9: step S14) are repeated.

15 In the screen picture shown in FIG. 7, when the mask buyer selects the "Purchase + Re-manufacture" button, the steps described above after the "Purchase" button is selected, and the steps described above after the "Re-manufacture" button is selected are performed 20 in parallel.

25 FIG. 8 is a view showing another screen picture displayed for the mask buyer, when the examination

results on the mask product do not conform to the examination specifications set out in the mask manufacture order. The examination data in this case further includes an optical simulation image to be  
5 formed when the mask product is used for a wafer. The optical simulation image is displayed as another screen picture when the mask buyer clicks on a cell in the "Simulation" column. Where the examination data includes an optical simulation image, the mask buyer is  
10 allowed to sufficiently study whether defects formed in the mask product are in a permissible range, when the mask product does not conform to the examination specifications.

In the embodiment described above, although only  
15 one mask factory 60 is connected to the host apparatus 20 of the mask trading system, a plurality of mask factories may be connected to the host apparatus 20 in parallel or in series. Where only one mask factory 60 is connected to the host apparatus 20 of the mask  
20 trading system, the data administering section 66 of the mask factory 60 and the host apparatus 20 of the mask trading system may be unified.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore,  
25 the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various

modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.